

What is claimed is:

1. A method for manufacturing a semiconductor device which includes a semiconductor substrate having a semiconductor circuit on a principal plane thereof, with through holes extending through said semiconductor substrate from said principal plane toward a rear surface thereof, and penetration electrodes formed in said through holes with their one ends protruded from the rear surface of said semiconductor substrate,

    said method comprising:

        a recess forming step of forming recesses in a substrate proper that has said semiconductor circuit formed on one surface thereof;

        an insulation film forming step of forming an insulation film on an inner wall surface of each of said recesses;

        an embedded electrode forming step of filling a conductive material into said recesses through said insulation films to form embedded electrodes that constitute said penetration electrodes;

        a penetration electrode forming step of forming said penetration electrodes by removing a rear side of said substrate proper opposite to said one surface thereof until one end face of each of said embedded electrodes is exposed;

        an anodic oxide film forming step of anodizing the rear surface of said substrate proper to form an anodic oxide film; and

        a semiconductor substrate forming step of forming said semiconductor substrate by removing said anodic oxide film by means of etching.

2. A method for manufacturing a semiconductor device which includes a semiconductor substrate having a semiconductor circuit on a principal plane thereof, with through holes extending through said semiconductor substrate from said principal plane toward a rear surface thereof, and penetration electrodes formed in said through holes with their one ends protruded from the rear surface of said semiconductor substrate,

said method comprising:

a recess forming step of forming recesses in a substrate proper that has said semiconductor circuit formed on one surface thereof;

an insulation film forming step of forming an insulation film on an inner wall surface of each of said recesses;

an embedded electrode forming step of filling a conductive material into said recesses through said insulation films to form embedded electrodes that constitute said penetration electrodes;

a removal step of removing a rear side of said substrate proper opposite to said one surface thereof until one end face of each of said embedded electrodes is exposed;

an anodic oxide film forming step of anodizing the rear surface of said substrate proper to form an anodic oxide film;

a semiconductor substrate forming step of removing said anodic oxide film by means of etching to form said penetration electrodes and said thinned semiconductor substrate; and

a removal step of removing said insulation films which cover one end portions of said penetration electrodes.

3. The method for manufacturing a semiconductor device as set forth in claim 1, wherein said anodic oxide film forming step of anodizing the rear surface of said substrate proper to form said anodic oxide film and said removal step of removing said anodic oxide film by means of etching are repeated a plurality of times.

4. The method for manufacturing a semiconductor device as set forth in claim 1, wherein the rear side of said semiconductor substrate is further anodized to form an anodic insulation film after said removal step of removing said anodic oxide film by means of etching.

5. The method for manufacturing a semiconductor device as set forth in claim 1, wherein said semiconductor substrate is made of silicon or

monocrystalline composed of silicon as its principal component, and said insulation films comprises silicon nitride films.